No of Pages : 3 Course Code: 08P401

Roll No:
(To be filled in by the candidate)

PSG COLLEGE OF TECHNOLOGY, COIMBATORE - 641 004

SEMESTER EXAMINATIONS, APRIL / MAY - 2011

BE / SW BE–ELECTRICAL AND ELECTRONICS / PRODUCTION ENGINEERING
Semester: 4 / 6

08P401 FLUID MECHANICS AND MACHINERY

Time: 3 Hours **Maximum Marks: 100**

INSTRUCTIONS:

1. Group I and Group II questions should be answered in the Main Answer Book.
2. Answer any **FIVE** questions in Group II.
3. Answer **ALL** questions in Group I and Group III.
4. Group III – **Multiple Choice questions** - (which will be given to the candidates half an hour before the scheduled close of the examination) **should be answered only** in the space provided **in the Main Answer Book.**
5. **Moody's Chart, Fluid properties table and Minor loss coefficient tables** is to be brought by the candidate to the exam hall.

GROUP I **Marks: 10 x 3 = 30**

1. What is the need for experimentation in fluid dynamics?
2. Draw the characteristic and system curves of a pump.
3. A fluid flow field is given by $V = x^2 y\, i + y^2 z\, j - (2xyz + yz^2)\, k$. Prove that it is a case of possible steady incompressible flow.
4. The velocity vector of a stream of fluid is given by $V = u\, i + v\, j$. Obtain the equation of the streamline.
5. State Buckingham's pi-theorem.
6. Why liquid bubbles are closely spherical in shape?
7. Why non-circular pipes are not generally used to transport liquids?
8. Define: vapor pressure.
9. What is the effect of the variation of stream velocity on boundary layer thickness? Justify your answer.
10. What is an inviscid region of flow?

GROUP II **Marks: 5 x 12 = 60**

11. A Francis turbine with an overall efficiency of 75% is required to produce 150 kW at the shaft. It is working under a head of 7.62 m. The wheel runs at 150 rpm and the hydraulic losses in the turbine are 22% of the available energy. Assuming radial discharge, determine (a) guide blade angle (b) vane angle at inlet (c) diameter of the wheel at the inlet (d) width of the wheel at the inlet. Take peripheral velocity = $0.26(2gH)^{1/2}$ and $V_{f1} = 0.96(2gH)^{1/2}$.

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12. Using control volume approach derive the momentum integral equation of a boundary layer flow and find the momentum integral equation of a flat plate boundary layer.

13. A concentric cylinder viscometer may be formed by rotating the inner member of the pair of closely fitting cylinders as shown in figure 1. For small clearances, a linear velocity profile may be assumed in the liquid filling the annular gap. A viscometer has an inner cylinder of 75mm diameter and 150mm height with a clearance gap width of 0.02mm. A torque of 0.021 Nm is required to turn the inner cylinder at 100 rpm. Determine the viscosity of the liquid in the clearance gap of the viscometer.

14. a) A flow is described by velocity field, V=ai + bxj, where b = 1/s and a = 2m/s. coordinates are measured in meters. Obtain the equation of the stream line passing through point (2, 5). At t=2s, what are the coordinates of the particle that passed through point (0, 4) at t=0s? (6)

    b) Consider a smooth sphere, of diameter D, immersed in a fluid moving with speed V. dimensional analysis predicts drag force = $\rho V^2 D^2$ Φ (Re, Ma). The force on a 3m diameter balloon in air moving at 1.5m/s is to be calculated from test data. The test is to be performed in water using a 50mm diameter model. Under dynamically similar conditions, the model drag force is measured as 3.78N. Evaluate the model test speed and the drag force expected on the full scale balloon. Assume temperature as 20°C. (6)

15. A fan is to be selected to ventilate a bathroom whose dimensions are 2 x 3 x 3 m. The air velocity is not to exceed 8 m/s to minimize vibration and noise. The combined efficiency of the fan-motor unit is taken as 50%. If the fan is to replace the entire volume of air in 10 minutes, determine a) the wattage of the fan-motor unit; b) diameter of the fan casing; c) pressure difference across the fan. Take the density of air to be 1.25kg/m^3.

16. In figure 2, there are 38 m of 2-in pipe, 23 m of 6-in pipe and 46 m of 3-in pipe all of cast iron. There are two 90° elbows and an open globe valve, all flanged. If the elevation of the reservoir is 30 m and the exit elevation is zero, what horsepower is extracted by the turbine when the flow rate is 4.53 L/s of water at 20° C?

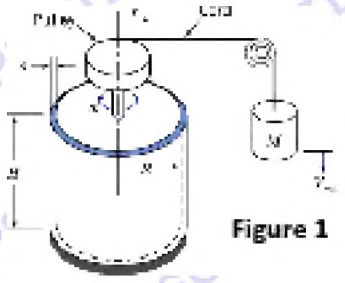

Figure 1

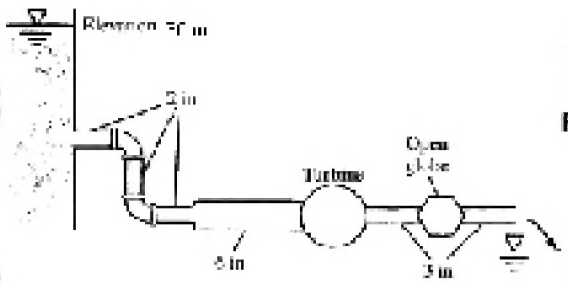

Figure 2

/END/

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Write the Alphabet of your choice answer for each question in the space provided in the Main Answer Book
(Do not attach this question paper along with the Main Answer Book)

08P401 FLUID MECHANICS AND MACHINERY

GROUP III **Marks: 10 x 1 = 10**

I) Draft tube converts large portion of kinetic energy of water flowing through it into
A) Kinetic energy **B)** Mechanical energy
C) Potential energy **D)** Pressure energy

II) For high head and low discharge, the suitable turbine is
A) Pelton **B)** Francis **C)** Kaplan **D)** Impeller

III) A computer cooling fan is a
A) ducted fan **B)** radial fan **C)** centrifugal fan **D)** centripetal fan

IV) Euler's number is ratio of
A) Inertia force to surface tension force **B)** Inertia force to drag force
C) Drag force to inertia force **D)** Pressure force to inertia force

V) The pressure at a point is equal in all direction
A) When fluid is inviscid **B)** When fluid at rest, regardless of its nature
C) Laminar flow **D)** Incompressible

VI) Capillarity rise and depression phenomena depends on
A) length of the tube **B)** diameter of the tube
C) Surface tension **D)** vapor pressure

VII) The integral momentum equation requires the assumption that the flow is
A) Uniform **B)** Unidirectional **C)** steady **D)** laminar

VIII) In Buckingham's π theorem, the number of repeating variables are equal to the number of
A) Dependent variables **B)** Fundamental dimensions
C) Independent variables **D)** dimension variables

IX) Golf balls have dimples because to
A) Create an early transition of turbulent layer
B) Maintain the pressure gradient
C) Prevent the boundary layer separation
D) Reduce the pressure gradient

X) The fluid layer adjacent to the solid surface has to do work against surface friction at the expense of its
A) Potential energy **B)** Pressure energy
C) Fluid energy **D)** Kinetic energy